

Rapid Charging AM Discussion

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Discussion Framework

- **Assume that battery system is an ideal blackbox, what would system need needed around that battery to allow rapid electric vehicle charging?**



Considerations for Infrastructure

- For 30 miles/min of charge, a rough energy delivery need would be 450 kW at 200 kHz
- Challenge of rapid charging is to not draw away energy from transmission lines during peak power demand hours that may be peak recharging hours



Considerations for Infrastructure

- Could install charge stations near or at sides of parking meters in urban city centers to increase access
- Fixed transportation routes (buses, electric vehicle fleets, car washes) could also be a point of installation
- Challenge is getting energy converted at a high conversion rate (~90%) from the grid to the EV battery.
- Need to reduce the cost of possible roadway electrification (currently~\$2 million/lane mile).

Potential & Issues with Wireless EV Charging

- Potential for in-motion charging could help eliminate and reduce range anxiety
- Wireless system approaches could be significantly more convenient than conductive charging and enable new approaches for EVs
- Wireless efficiency issue: conductive losses of 20-30% losses can occur due to airgaps



Potential & Issues with Wireless EV Charging

- Installation of wireless installations would need to be near where high power transmission lines are placed or near large generation facilities that could handle load
- Wireless cost issue: Between civil engineering, grid interaction, and large power electronics, the cost could roughly be ~\$2.75 million per lane mile



System & Infrastructure Challenges

Cables

- Material used, is copper only option?
- Cable contact system and resistance
- Cable length reduction for efficiency and cost
- Battery cabling/weight of cable for widespread spectrum of users
- Diameter & Safety to enable reliable and low-risk operation



System & Infrastructure Challenges

Power electronics

- Scaling: future applications that use mobile power electronics (engine, transmission)
- Systems need reconfiguration per application; unique design per system increases cost
- Solid state transformers and distribution voltage issues for allowing widespread rapid charging
- On board vehicle electronics weight, size, contact and thermal issues will need development

System & Infrastructure Challenges

Economic models

- Need to understand total equivalent costs of filling up at a gas station (per mile and/or per minute)
- Buyer buying electricity directly through utility or third party?
- What is the model for ownership of stations?
- What type of scale would be required to decrease costs?
- Minimal # of rapid charging EVs on the road to adopt